



109272-150.ST25

SEQUENCE LISTING

**COPY OF PAPERS
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<120> lovE Variant Regulator Molecules

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<140> US 09/974,760

<141> 2001-10-09

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 <210> 35
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 <400> 36
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 <210> 38
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 <400> 38
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 <400> 39
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 <210> 40
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<223> Amino acid sequence of variants of the lovE Gene

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Val Glu Gly Ser Arg Thr Gly Gly Thr Leu Pro Arg Arg Ala Phe Arg
           20           25           30
Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
 35           40           45
Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
 50           55           60
Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg Gln
 65           70           75           80
Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
           85           90           95
Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
           100          105          110
Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
           115          120          125
Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Glu Ala Ile Asp
 130          135          140
Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
 145          150          155          160
Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
           165          170          175
Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
           180          185          190
Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
           195          200          205
Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
 210          215          220
Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
 225          230          235          240
Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys Arg Gln Gly Thr
           245          250          255
Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
           260          265          270
Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
           275          280          285
Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
           290          295          300
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
 305          310          315          320
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
           325          330          335
Gly Glu Leu Phe Pro Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
           340          345          350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
           355          360          365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
           370          375          380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
 385          390          395          400

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Ser Ala Arg Cys Glu Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
 405 410 415
 Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
 420 425 430
 Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
 435 440 445
 Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
 450 455 460
 Asn Asn Ile Pro Pro
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<210> 42
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 <223> Amino acid sequence of variants of the lovE Gene

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 Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
 35 40 45
 Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
 50 55 60
 Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg Gln
 65 70 75 80
 Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
 85 90 95
 Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
 100 105 110
 Glu Ser His Ser Ser Asn Thr Ser Trp Gln Phe Leu Asp Pro Pro Asp
 115 120 125
 Ser Tyr Asp Trp Leu Trp Thr Ser Ile Gly Thr Asp Glu Ala Ile Asp
 130 135 140
 Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
 145 150 155 160
 Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
 165 170 175
 Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
 180 185 190
 Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
 195 200 205
 Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
 210 215 220
 Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
 225 230 235 240
 Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
 245 250 255
 Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
 260 265 270
 Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
 275 280 285

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Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
 290                295                300
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
305                310                315                320
His Gly Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
                325                330                335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
                340                345                350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
                355                360                365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
                370                375                380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
385                390                395                400
Ser Ala Arg Cys Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
                405                410                415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
                420                425                430
Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
                435                440                445
Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
                450                455                460
Asn Asn Ile Pro Pro
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<210> 43

<211> 469

<212> PRT

<213> Artificial Sequence

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<223> Amino acid sequence of variants of the lovE Gene

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                20                25                30
Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
                35                40                45
Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
                50                55                60
Leu Arg Cys Val Tyr Ser Glu Arg Arg Pro Lys Arg Lys Leu Arg Gln
65                70                75                80
Ser Arg Val Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
                85                90                95
Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
                100                105                110
Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
                115                120                125
Ser Tyr Asp Trp Ser Trp Ile Ser Ile Gly Thr Asp Glu Ala Ile Asp
130                135                140
Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
145                150                155                160
Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
                165                170                175

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Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
 180 185 190
 Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
 195 200 205
 Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
 210 215 220
 Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
 225 230 235 240
 Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
 245 250 255
 Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
 260 265 270
 Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
 275 280 285
 Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
 290 295 300
 Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
 305 310 315 320
 His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
 325 330 335
 Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
 340 345 350
 Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
 355 360 365
 Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
 370 375 380
 Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
 385 390 395 400
 Ser Ala Arg Cys Glu Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
 405 410 415
 Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
 420 425 430
 Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
 435 440 445
 Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
 450 455 460
 Asn Asn Ile Pro Pro
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<210> 44

<211> 469

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<213> Artificial Sequence

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<223> Amino acid sequence of variants of the lovE Gene

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 20 25 30
 Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
 35 40 45
 Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
 50 55 60

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Leu Arg Cys Val Tyr Ser Glu Arg Arg Pro Lys Arg Lys Leu Arg Gln
65      70      75      80
Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
      85      90      95
Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
      100      105      110
Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
      115      120      125
Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Glu Ala Ile Asp
      130      135      140
Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
145      150      155      160
Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
      165      170      175
Gly Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
      180      185      190
Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
      195      200      205
Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
      210      215      220
Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
225      230      235      240
Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
      245      250      255
Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
      260      265      270
Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
      275      280      285
Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
      290      295      300
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
305      310      315      320
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
      325      330      335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
      340      345      350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
      355      360      365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
      370      375      380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
385      390      395      400
Ser Ala Arg Cys Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
      405      410      415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
      420      425      430
Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
      435      440      445
Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
      450      455      460
Asn Asn Ile Pro Pro
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<210> 45
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<213> Artificial Sequence

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<223> Amino acid sequence of variants of the lovE Gene

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Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
          35           40           45
Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
          50           55           60
Leu Arg Cys Val Tyr Ser Glu Arg Arg Pro Lys Arg Lys Leu Arg Gln
65          70          75          80
Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
          85          90          95
Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
          100         105         110
Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
          115         120         125
Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Glu Ala Ile Asp
130         135         140
Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
145         150         155         160
Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
          165         170         175
Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
          180         185         190
Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
          195         200         205
Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
210         215         220
Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
225         230         235         240
Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
          245         250         255
Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
          260         265         270
Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
          275         280         285
Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
290         295         300
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
305         310         315         320
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
          325         330         335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
          340         345         350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
          355         360         365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
370         375         380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
385         390         395         400
Ser Ala Arg Cys Glu Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu

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405 410 415
 Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
 420 425 430
 Gly Ser Arg Gly Arg Thr Ile Ala Leu Arg Arg Cys Tyr Glu Asp
 435 440 445
 Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
 450 455 460
 Asn Asn Ile Pro Pro
 465

<210> 46
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<220>
 <223> Amino acid sequence of variants of the lovE Gene

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 20 25 30
 Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
 35 40 45
 Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
 50 55 60
 Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg Gln
 65 70 75 80
 Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
 85 90 95
 Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
 100 105 110
 Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
 115 120 125
 Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Glu Ala Ile Asp
 130 135 140
 Thr Asp Cys Trp Gly Leu Ser Gln Tyr Asp Gly Gly Phe Ser Cys Gln
 145 150 155 160
 Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
 165 170 175
 Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
 180 185 190
 Ser Ala Gln Arg Lys Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
 195 200 205
 Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
 210 215 220
 Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
 225 230 235 240
 Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
 245 250 255
 Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
 260 265 270
 Tyr Ile Leu Asn Val Arg Ile Leu Ala Ala Ile Ser Glu Leu Leu Leu
 275 280 285
 Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly

```

      290              295              300
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
305              310              315              320
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
              325              330              335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
              340              345              350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
              355              360              365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
              370              375              380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
385              390              395              400
Ser Ala Arg Cys Glu Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
              405              410              415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
              420              425              430
Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
              435              440              445
Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
              450              455              460
Asn Asn Ile Pro Pro
465

```

<210> 47

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 47

```

Met Ala Ala Asp Gln Gly Ile Phe Thr Asn Ser Val Thr Leu Ser Pro
1      5      10      15
Val Glu Gly Ser Arg Thr Gly Gly Thr Leu Pro Arg Arg Ala Phe Arg
20      25      30
Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
35      40      45
Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
50      55      60
Leu Arg Cys Val Tyr Ser Glu Arg Arg Pro Lys Arg Lys Leu Arg Gln
65      70      75      80
Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
85      90      95
Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
100      105      110
Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
115      120      125
Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Glu Ala Ile Asp
130      135      140
Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
145      150      155      160
Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
165      170      175
Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala

```



```

      180              185              190
Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
      195              200              205
Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
      210              215              220
Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
      225              230              235
Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Ala
      245              250              255
Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
      260              265              270
Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
      275              280              285
Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
      290              295              300
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
      305              310              315
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
      325              330              335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
      340              345              350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
      355              360              365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
      370              375              380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
      385              390              395
Ser Ala Arg Cys Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
      405              410              415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
      420              425              430
Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
      435              440              445
Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
      450              455              460
Asn Ser Ile Pro Pro
      465

```

<210> 48

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 48

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Met Ala Ala Asp Gln Gly Ile Phe Thr Asn Ser Val Thr Leu Ser Pro
  1              5              10              15
Val Glu Gly Ser Arg Thr Gly Gly Thr Leu Pro Arg Arg Ala Phe Arg
      20              25              30
Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
      35              40              45
Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
      50              55              60
Leu Arg Cys Val Tyr Ser Glu Arg Arg Pro Lys Arg Lys Leu Arg Gln

```

65					70				75				80
Ser	Arg	Ala	Ala	Asp	Leu	Val	Ser	Ala	Asp	Pro	Asp	Pro	Cys
				85					90				95
Met	Ser	Ser	Pro	Pro	Val	Pro	Ser	Gln	Ser	Leu	Pro	Leu	Asp
			100					105					110
Glu	Ser	His	Ser	Ser	Asn	Thr	Ser	Arg	Gln	Phe	Leu	Asp	Pro
		115					120					125	Pro
Ser	Tyr	Asp	Trp	Ser	Trp	Thr	Ser	Ile	Gly	Thr	Asp	Glu	Ala
	130					135					140		Ile
Thr	Asp	Cys	Trp	Gly	Leu	Ser	Gln	Cys	Asp	Gly	Gly	Phe	Ser
145					150					155			Cys
Leu	Glu	Pro	Thr	Leu	Pro	Asp	Leu	Pro	Ser	Pro	Phe	Glu	Ser
				165					170				Thr
Glu	Lys	Ala	Pro	Leu	Pro	Pro	Val	Ser	Ser	Asp	Ile	Ala	Arg
		180						185					Ala
Ser	Ala	Gln	Arg	Glu	Leu	Phe	Asp	Asp	Leu	Ser	Ala	Val	Ser
	195						200					205	Gln
Leu	Glu	Glu	Ile	Leu	Leu	Ala	Val	Thr	Val	Glu	Trp	Pro	Lys
	210					215					220		Gln
Ile	Trp	Thr	His	Pro	Ile	Gly	Met	Phe	Phe	Asn	Ala	Ser	Arg
225					230					235			Arg
Leu	Thr	Val	Leu	Arg	Gln	Gln	Ala	Gln	Ala	Asp	Cys	His	Gln
				245					250				Gly
Leu	Asp	Glu	Cys	Leu	Arg	Thr	Lys	Asn	Leu	Phe	Thr	Ala	Val
			260					265					His
Tyr	Ile	Leu	Asn	Val	Arg	Ile	Leu	Thr	Ala	Ile	Ser	Glu	Leu
	275						280					285	Leu
Ser	Gln	Ile	Arg	Arg	Thr	Gln	Asn	Ser	His	Met	Ser	Pro	Leu
	290					295					300		Gly
Ser	Arg	Ser	Gln	Ser	Pro	Ser	Arg	Asp	Asp	Thr	Ser	Ser	Ser
305					310					315			Gly
His	Ser	Ser	Val	Asp	Thr	Ile	Pro	Phe	Phe	Ser	Glu	Asn	Leu
				325					330				Pro
Gly	Glu	Leu	Phe	Ser	Tyr	Val	Asp	Pro	Leu	Thr	His	Ala	Leu
			340					345					Phe
Ala	Cys	Thr	Thr	Leu	His	Val	Gly	Val	Gln	Leu	Leu	Arg	Glu
	355						360					365	Asn
Ile	Thr	Leu	Gly	Val	His	Ser	Ala	Gln	Gly	Ile	Ala	Ala	Ser
	370					375					380		Ile
Met	Ser	Gly	Glu	Pro	Gly	Glu	Asp	Ile	Ala	Arg	Thr	Gly	Ala
385					390					395			Thr
Ser	Ala	Arg	Cys	Glu	Glu	Gln	Pro	Thr	Thr	Pro	Ala	Ala	Arg
				405					410				Val
Phe	Met	Phe	Leu	Ser	Asp	Glu	Gly	Ala	Phe	Gln	Glu	Ala	Lys
			420					425					Ser
Gly	Ser	Arg	Gly	Arg	Thr	Ile	Ala	Ala	Leu	Arg	Arg	Cys	Tyr
		435					440					445	Glu
Ile	Phe	Ser	Leu	Ala	Arg	Lys	His	Lys	His	Gly	Met	Leu	Arg
	450					455					460		Asp
Asn	Ser	Ile	Pro	Pro									Leu
465													

<210> 49

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 49

```

Met Ala Ala Asp Gln Gly Ile Phe Thr Asn Ser Val Thr Leu Ser Pro
1      5      10      15
Val Glu Gly Ser Arg Thr Gly Gly Thr Leu Pro Arg Arg Ala Phe Arg
20      25      30
Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
35      40      45
Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
50      55      60
Leu Arg Cys Val Tyr Ser Glu Arg Arg Pro Lys Arg Lys Leu Arg Gln
65      70      75      80
Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
85      90      95
Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
100     105     110
Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
115     120     125
Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Glu Ala Ile Asp
130     135     140
Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
145     150     155     160
Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
165     170     175
Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
180     185     190
Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
195     200     205
Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
210     215     220
Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
225     230     235     240
Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Ala
245     250     255
Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
260     265     270
Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
275     280     285
Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
290     295     300
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
305     310     315     320
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
325     330     335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
340     345     350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
355     360     365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
370     375     380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
385     390     395     400
Ser Ala Arg Cys Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
405     410     415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala

```

			420					425					430				
Gly	Ser	Arg	Gly	Arg	Thr	Ile	Ala	Ala	Leu	Arg	Arg	Cys	Tyr	Glu	Asp		
		435					440					445					
Ile	Phe	Ser	Leu	Ala	Arg	Lys	His	Lys	His	Gly	Met	Leu	Arg	Asp	Leu		
		450				455					460						
Asn	Ser	Ile	Pro	Pro													
465																	

<210> 50

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 50

Met	Ala	Ala	Asp	Gln	Gly	Ile	Phe	Thr	Asn	Ser	Val	Thr	Leu	Ser	Pro		
1			5					10					15				
Val	Glu	Gly	Ser	Arg	Thr	Gly	Gly	Thr	Leu	Pro	Arg	Arg	Ala	Phe	Arg		
		20				25						30					
Arg	Ser	Cys	Asp	Arg	Cys	His	Ala	Gln	Lys	Ile	Lys	Cys	Thr	Gly	Asn		
		35				40						45					
Lys	Glu	Val	Thr	Gly	Arg	Ala	Pro	Cys	Gln	Arg	Cys	Gln	Gln	Ala	Gly		
	50				55				60								
Leu	Arg	Cys	Val	Tyr	Ser	Glu	Arg	Arg	Pro	Lys	Arg	Lys	Leu	Arg	Gln		
65			70					75							80		
Ser	Arg	Ala	Ala	Asp	Leu	Val	Ser	Ala	Asp	Pro	Asp	Pro	Cys	Leu	His		
			85					90						95			
Met	Ser	Ser	Pro	Pro	Val	Pro	Ser	Gln	Ser	Leu	Pro	Leu	Asp	Val	Ser		
			100					105					110				
Glu	Ser	His	Ser	Ser	Asn	Thr	Ser	Arg	Gln	Phe	Leu	Asp	Pro	Pro	Asp		
		115				120						125					
Ser	Tyr	Asp	Trp	Ser	Trp	Thr	Ser	Ile	Gly	Thr	Asp	Glu	Ala	Ile	Asp		
	130					135					140						
Thr	Asp	Cys	Trp	Gly	Leu	Ser	Gln	Cys	Asp	Gly	Gly	Phe	Ser	Cys	Gln		
145				150						155					160		
Leu	Glu	Pro	Thr	Leu	Pro	Asp	Leu	Pro	Ser	Pro	Phe	Glu	Ser	Thr	Val		
			165					170						175			
Glu	Lys	Ala	Pro	Leu	Pro	Pro	Val	Ser	Ser	Asp	Ile	Ala	Arg	Ala	Ala		
		180						185					190				
Ser	Ala	Gln	Arg	Glu	Leu	Phe	Asp	Asp	Leu	Ser	Ala	Val	Ser	Gln	Glu		
		195				200						205					
Leu	Glu	Glu	Ile	Leu	Leu	Ala	Val	Thr	Val	Glu	Trp	Pro	Lys	Gln	Glu		
	210					215					220						
Ile	Trp	Thr	His	Pro	Ile	Gly	Met	Phe	Phe	Asn	Ala	Ser	Arg	Arg	Leu		
225				230						235					240		
Leu	Thr	Val	Leu	Arg	Gln	Gln	Ala	Gln	Ala	Asp	Cys	His	Gln	Gly	Ala		
			245					250						255			
Leu	Asp	Glu	Cys	Leu	Arg	Thr	Lys	Asn	Leu	Phe	Thr	Ala	Val	His	Cys		
		260						265					270				
Tyr	Ile	Leu	Asn	Val	Arg	Ile	Leu	Thr	Ala	Ile	Ser	Glu	Leu	Leu	Leu		
	275					280						285					
Ser	Gln	Ile	Arg	Arg	Thr	Gln	Asn	Ser	His	Met	Ser	Pro	Leu	Glu	Gly		
	290					295					300						
Ser	Arg	Ser	Gln	Ser	Pro	Ser	Arg	Asp	Asp	Thr	Ser	Ser	Ser	Ser	Gly		

```

305          310          315          320
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
          325          330          335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
          340          345          350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
          355          360          365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
          370          375          380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
385          390          395          400
Ser Ala Arg Cys Glu Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
          405          410          415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
          420          425          430
Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
          435          440          445
Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
          450          455          460
Asn Ser Ile Pro Pro
465

```

<210> 51

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 51

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Met Ala Ala Asp Gln Gly Ile Phe Met Asn Ser Val Thr Leu Ser Ala
1          5          10          15
Val Glu Gly Ser Arg Thr Ser Gly Thr Leu Pro Arg Arg Ala Phe Arg
          20          25          30
Arg Ser Cys Asp Arg Cys His Ala Lys Lys Ile Lys Cys Thr Gly Asn
          35          40          45
Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
          50          55          60
Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg Gln
65          70          75          80
Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
          85          90          95
Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
          100          105          110
Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
          115          120          125
Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Glu Ala Ile Asp
          130          135          140
Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
145          150          155          160
Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
          165          170          175
Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
          180          185          190
Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu

```

```

      195              200              205
Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
  210              215              220
Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
  225              230              235
Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
      245              250              255
Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
      260              265              270
Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
      275              280              285
Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
      290              295              300
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
  305              310              315
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
      325              330              335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
      340              345              350
Ala Cys Thr Thr Leu His Val Gly Val Glu Leu Leu Arg Glu Asn Glu
      355              360              365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
      370              375              380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
  385              390              395
Ser Ala Arg Cys Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
      405              410              415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
      420              425              430
Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
      435              440              445
Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
      450              455              460
Asn Asn Ile Pro Pro
  465

```

<210> 52

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 52

```

Met Ala Ala Asp Gln Gly Ile Phe Thr Asn Ser Val Thr Leu Ser Pro
  1              5              10              15
Val Glu Gly Ser His Thr Gly Gly Thr Leu Pro Arg Arg Ala Phe Arg
      20              25              30
Arg Ala Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
      35              40              45
Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
      50              55              60
Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg His
      65              70              75              80
Ser Arg Ala Ser Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His

```

				85				90					95				
Met	Ser	Ser	Pro	Pro	Val	Pro	Ser	Gln	Ser	Leu	Pro	Leu	Asp	Val	Ser		
			100					105					110				
Glu	Ser	His	Ser	Ser	Asn	Thr	Ser	Arg	Gln	Phe	Leu	Asp	Pro	Pro	Asp		
		115					120					125					
Ser	Tyr	Asp	Trp	Ser	Trp	Thr	Ser	Ile	Gly	Thr	Asp	Glu	Ala	Ile	Asp		
	130					135					140						
Thr	Asp	Cys	Trp	Gly	Leu	Ser	Gln	Cys	Asp	Gly	Gly	Phe	Ser	Cys	Gln		
145				150						155					160		
Leu	Glu	Pro	Thr	Leu	Pro	Asp	Leu	Pro	Ser	Pro	Phe	Glu	Ser	Thr	Val		
			165					170							175		
Glu	Lys	Ala	Pro	Leu	Pro	Pro	Val	Ser	Ser	Asp	Ile	Ala	Arg	Ala	Ala		
		180						185				190					
Ser	Ala	Gln	Arg	Glu	Leu	Phe	Asp	Asp	Leu	Ser	Ala	Val	Ser	Gln	Glu		
	195						200					205					
Leu	Glu	Glu	Ile	Leu	Leu	Ala	Val	Thr	Val	Glu	Trp	Pro	Lys	Gln	Glu		
	210					215					220						
Ile	Trp	Thr	His	Pro	Ile	Gly	Met	Phe	Phe	Asn	Ala	Ser	Arg	Arg	Leu		
225				230						235					240		
Leu	Thr	Val	Leu	Arg	Gln	Gln	Ala	Gln	Ala	Asp	Cys	His	Gln	Gly	Thr		
			245					250						255			
Leu	Asp	Glu	Cys	Leu	Arg	Thr	Lys	Asn	Leu	Phe	Thr	Ala	Val	His	Cys		
		260					265					270					
Tyr	Ile	Leu	Asn	Val	Arg	Ile	Leu	Thr	Ala	Ile	Ser	Glu	Leu	Leu	Leu		
	275					280					285						
Ser	Gln	Ile	Arg	Arg	Thr	Gln	Asn	Ser	His	Met	Ser	Pro	Leu	Asp	Gly		
	290				295						300						
Ser	Arg	Ser	Gln	Ser	Pro	Ser	Arg	Asp	Asp	Thr	Ser	Ser	Ser	Ser	Gly		
305				310					315						320		
His	Ser	Ser	Val	Asp	Thr	Ile	Pro	Phe	Phe	Ser	Glu	Asn	Leu	Pro	Ile		
			325					330						335			
Gly	Glu	Leu	Phe	Ser	Tyr	Val	Asp	Pro	Leu	Thr	His	Ala	Leu	Phe	Ser		
		340					345					350					
Ala	Cys	Thr	Thr	Leu	His	Val	Gly	Val	Gln	Leu	Leu	Arg	Glu	Asn	Glu		
	355					360					365						
Ile	Thr	Leu	Gly	Val	Asp	Ser	Ala	Gln	Gly	Ile	Ala	Ala	Ser	Ile	Ser		
	370				375					380							
Met	Ser	Gly	Glu	Pro	Gly	Glu	Asp	Ile	Ala	Arg	Thr	Gly	Ala	Thr	Asn		
385				390					395						400		
Ser	Ala	Arg	Cys	Glu	Glu	Gln	Pro	Thr	Thr	Pro	Ala	Ala	Arg	Val	Leu		
			405				410							415			
Phe	Met	Phe	Leu	Ser	Asp	Glu	Gly	Ala	Phe	Gln	Glu	Ala	Lys	Ser	Ala		
		420					425					430					
Gly	Ser	Arg	Gly	Arg	Thr	Ile	Thr	Val	Leu	Arg	Arg	Ser	Tyr	Glu	Asp		
	435					440					445						
Ile	Phe	Ser	Leu	Ala	Arg	Lys	His	Lys	His	Gly	Met	Leu	Arg	Asp	Leu		
	450				455						460						
Asn	Asn	Ile	Pro	Ser													
465																	

<210> 53

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 53

```

Met Ala Ala Asp Gln Gly Ile Phe Thr Asn Ser Val Thr Leu Ser Pro
 1      5      10      15
Val Glu Gly Ser Arg Thr Gly Gly Thr Leu Pro Arg Arg Ala Leu Arg
 20      25      30
Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
 35      40      45
Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
 50      55      60
Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg Gln
 65      70      75      80
Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
 85      90      95
Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
100      105      110
Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
115      120      125
Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Glu Ala Ile Asp
130      135      140
Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
145      150      155      160
Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
165      170      175
Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
180      185      190
Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
195      200      205
Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
210      215      220
Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
225      230      235      240
Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
245      250      255
Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
260      265      270
Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
275      280      285      290
Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
295      300      305
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
310      315      320
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
325      330      335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
340      345      350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
355      360      365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
370      375      380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
385      390      395      400
Ser Ala Arg Cys Glu Glu Gln Pro Ile Thr Pro Ala Ala Arg Val Leu
405      410      415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
420      425      430

```


Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
 435 440 445
 Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
 450 455 460
 Asn Asn Ile Pro Pro
 465

<210> 54

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 54

Met Ala Ala Asp Gln Gly Ile Phe Thr Asn Ser Val Thr Leu Ser Pro
 1 5 10 15
 Val Glu Gly Ser Arg Thr Gly Gly Thr Leu Pro Arg Arg Ala Leu Arg
 20 25 30
 Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
 35 40 45
 Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
 50 55 60
 Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg Gln
 65 70 75 80
 Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
 85 90 95
 Ile Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
 100 105 110
 Asp Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
 115 120 125
 Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Glu Ala Ile Asp
 130 135 140
 Thr Asn Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
 145 150 155 160
 Leu Glu Ser Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
 165 170 175
 Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
 180 185 190
 Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
 195 200 205
 Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
 210 215 220
 Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
 225 230 235 240
 Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
 245 250 255
 Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
 260 265 270
 Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
 275 280 285
 Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
 290 295 300
 Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
 305 310 315 320

```

His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
      325      330      335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
      340      345      350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Ile Glu
      355      360      365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
      370      375      380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
385      390      395      400
Ser Ala Arg Cys Glu Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
      405      410      415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
      420      425      430
Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
      435      440      445
Ile Phe Ser Leu Ala Arg Lys His Lys Tyr Gly Met Leu Arg Asp Leu
      450      455      460
Asn Asn Ile Pro Pro
465

```

<210> 55

<211> 470

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 55

```

Met Ala Ala Asp Gln Gly Ile Phe Thr Asn Ser Val Thr Leu Ser Pro
1      5      10      15
Val Glu Gly Ser Arg Thr Gly Gly Thr Leu Pro Arg Arg Ala Phe Arg
20      25      30
Arg Ser Cys Asp Arg Cys His Ala Gln Lys Val Lys Cys Thr Gly Asn
35      40      45
Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
50      55      60
Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg Gln
65      70      75      80
Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
85      90      95
Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
100      105      110
Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
115      120      125
Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Glu Ala Ile Asp
130      135      140
Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
145      150      155      160
Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
165      170      175
Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
180      185      190
Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
195      200      205

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```

Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
 210          215          220
Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
225          230          235          240
Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
          245          250          255
Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
          260          265          270
Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
          275          280          285
Ser Gln Ile Arg Arg Thr Leu Asn Ser His Met Ser Pro Leu Glu Gly
          290          295          300
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
305          310          315          320
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
          325          330          335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
          340          345          350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
          355          360          365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
          370          375          380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
385          390          395          400
Ser Ala Arg Cys Glu Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
          405          410          415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
          420          425          430
Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
          435          440          445
Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
          450          455          460
Asn Asn Ile Pro Pro Cys
465          470

```

<210> 56

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 56

```

Met Ala Ala Asp Gln Gly Ile Phe Thr Asn Ser Val Thr Leu Ser Pro
 1          5          10          15
Val Glu Gly Ser Arg Thr Gly Gly Thr Leu Pro Arg Arg Ala Leu Arg
          20          25          30
Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
          35          40          45
Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
          50          55          60
Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg Gln
65          70          75          80
Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
          85          90          95

```

```

Met Ser Ser Pro Ser Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
      100      105      110
Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
      115      120      125
Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Glu Ala Ile Asp
      130      135      140
Thr Asp Cys Trp Gly Leu Ser Gln Arg Asp Gly Gly Phe Ser Ser Gln
      145      150      155      160
Leu Lys Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
      165      170      175
Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
      180      185      190
Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
      195      200      205
Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
      210      215      220
Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
      225      230      235      240
Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
      245      250      255
Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
      260      265      270
Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
      275      280      285
Ser Gln Ile Arg Leu Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
      290      295      300
Ser Arg Ser Gln Ser Pro Asn Arg Asp Asp Thr Ser Ser Ser Ser Gly
      305      310      315      320
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
      325      330      335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
      340      345      350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
      355      360      365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
      370      375      380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
      385      390      395      400
Ser Ala Arg Cys Glu Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
      405      410      415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
      420      425      430
Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
      435      440      445
Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
      450      455      460
Asn Asn Ile Pro Pro
465

```

<210> 57

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 57

```

Met Ala Ala Asp Gln Gly Ile Phe Thr Asn Ser Val Thr Ile Ser Pro
 1      5      10      15
Val Val Gly Ser Arg Thr Gly Gly Thr Leu Pro Arg Arg Ala Phe Arg
 20      25      30
Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
 35      40      45
Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
 50      55      60
Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg Gln
 65      70      75      80
Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
 85      90      95
Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
100      105      110
Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
115      120      125
Ser Tyr Asp Trp Ser Trp Thr Ser Ile Cys Thr Asp Glu Ala Ile Asp
130      135      140
Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
145      150      155      160
Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
165      170      175
Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
180      185      190
Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
195      200      205
Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
210      215      220
Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
225      230      235      240
Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
245      250      255
Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
260      265      270
Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
275      280      285
Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
290      295      300
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
305      310      315      320
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
325      330      335
Gly Gly Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
340      345      350
Ala Cys Thr Thr Leu His Val Gly Leu Gln Leu Leu Arg Glu Asn Glu
355      360      365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
370      375      380
Met Ser Gly Glu Ser Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Ser
385      390      395      400
Ser Ala Arg Cys Glu Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
405      410      415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
420      425      430
Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
435      440      445

```

Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
 450 455 460
 Asn Asn Ile Pro Pro
 465

<210> 58
 <211> 469
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Amino acid sequence of variants of the lovE Gene

<400> 58
 Met Ala Ala Asp Gln Gly Ile Phe Thr Asn Ser Val Thr Leu Ser Pro
 1 5 10 15
 Val Glu Gly Ser Arg Thr Gly Gly Thr Leu Pro Arg Arg Ala Phe Arg
 20 25 30
 Arg Ser Cys Asp Arg Cys His Ala Arg Lys Ile Lys Cys Thr Gly Asn
 35 40 45
 Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
 50 55 60
 Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg Gln
 65 70 75 80
 Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
 85 90 95
 Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
 100 105 110
 Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
 115 120 125
 Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Glu Ala Ile Asp
 130 135 140
 Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
 145 150 155 160
 Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Tyr Thr Val
 165 170 175
 Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
 180 185 190
 Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
 195 200 205
 Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
 210 215 220
 Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
 225 230 235 240
 Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
 245 250 255
 Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
 260 265 270
 Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
 275 280 285
 Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
 290 295 300
 Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
 305 310 315 320
 His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
 325 330 335

```

Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
      340      345      350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
      355      360      365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
      370      375      380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
385      390      395      400
Ser Thr Arg Cys Glu Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
      405      410      415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
      420      425      430
Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
      435      440      445
Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
      450      455      460
Asn Asn Ile Pro Pro
465

```

<210> 59

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 59

```

Met Ala Ala Asp Gln Gly Ile Phe Thr Asn Ser Val Thr Leu Ser Pro
 1      5      10      15
Val Glu Gly Ser Arg Thr Gly Gly Thr Leu Pro Arg Arg Ala Leu Arg
      20      25      30
Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
      35      40      45
Lys Glu Val Ile Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
      50      55      60
Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg Gln
65      70      75      80
Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
      85      90      95
Met Ser Ser Pro Gln Val Pro Ser Gln Ser Leu Ser Leu Asp Ile Ser
      100      105      110
Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
      115      120      125
Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Glu Ala Ile Asp
      130      135      140
Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
145      150      155      160
Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
      165      170      175
Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
      180      185      190
Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
      195      200      205
Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
      210      215      220

```

```

Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
225          230          235          240
Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
          245          250          255
Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
          260          265          270
Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
          275          280          285
Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
          290          295          300
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
305          310          315          320
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
          325          330          335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
          340          345          350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
          355          360          365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
          370          375          380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
385          390          395          400
Ser Ala Arg Cys Glu Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
          405          410          415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
          420          425          430
Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
          435          440          445
Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
          450          455          460
Asn Asn Ile Pro Pro
465

```

<210> 60

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 60

```

Met Ala Ala Asp Gln Gly Ile Phe Thr Asn Ser Val Thr Leu Ser Pro
1          5          10          15
Val Glu Gly Ser Arg Thr Gly Gly Thr Leu Pro Arg Arg Ala Phe Arg
          20          25          30
Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
          35          40          45
Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
          50          55          60
Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg Gln
65          70          75          80
Ser Arg Ala Ala Asn Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
          85          90          95
Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
          100          105          110

```



```

Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
   115                               120               125
Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Glu Ala Phe Asp
   130                               135               140
Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
  145                               150               155               160
Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Ser Pro Phe Glu Ser Thr Val
                               165               170               175
Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
                               180               185               190
Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
   195                               200               205
Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
   210                               215               220
Ile Trp Thr His Pro Ile Gly Ile Phe Phe Asn Ala Ser Arg Arg Leu
  225                               230               235               240
Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
                               245               250               255
Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
   260                               265               270
Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
   275                               280               285
Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
   290                               295               300
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Ile Ser Ser Ser Ser Gly
  305                               310               315               320
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
                               325               330               335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
   340                               345               350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
   355                               360               365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Tyr Ile Ser
   370                               375               380
Lys Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
  385                               390               395               400
Ser Ala Arg Cys Glu Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
   405                               410               415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
   420                               425               430
Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
   435                               440               445
Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
   450                               455               460
Asn Asn Ile Pro Pro
465

```

<210> 61

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 61

Met	Ala	Ala	Asp	Gln	Gly	Ile	Phe	Thr	Asn	Ser	Val	Thr	Leu	Ser	Pro	1	5	10	15
Val	Glu	Gly	Ser	Arg	Thr	Gly	Gly	Thr	Leu	Pro	Arg	Arg	Ala	Phe	Arg	20	25	30	
Arg	Ser	Cys	Asp	Arg	Cys	His	Ala	Gln	Lys	Ile	Lys	Cys	Ile	Gly	Asn	35	40	45	
Lys	Glu	Val	Thr	Gly	Arg	Ala	Pro	Cys	Gln	Arg	Cys	Gln	Arg	Ala	Gly	50	55	60	
Leu	Arg	Cys	Val	Tyr	Ser	Glu	Arg	Cys	Pro	Lys	Arg	Arg	Leu	Arg	Gln	65	70	75	80
Ser	Arg	Ala	Ala	Asp	Leu	Val	Ser	Ala	Asp	Pro	Asp	Pro	Cys	Leu	His	85	90	95	
Met	Ser	Ser	Pro	Pro	Val	Pro	Ser	Gln	Ser	Leu	Pro	Leu	Asp	Val	Ser	100	105	110	
Glu	Ser	His	Ser	Ser	Asn	Thr	Ser	Arg	Gln	Phe	Leu	Asp	Pro	Pro	Asp	115	120	125	
Ser	Tyr	Asp	Trp	Ser	Trp	Thr	Ser	Ile	Gly	Thr	Asp	Glu	Ala	Ile	Asp	130	135	140	
Thr	Asp	Cys	Trp	Gly	Leu	Ser	Gln	Cys	Asp	Gly	Gly	Phe	Ser	Cys	Gln	145	150	155	160
Leu	Glu	Pro	Thr	Leu	Pro	Asp	Leu	Pro	Ser	Pro	Phe	Glu	Ser	Thr	Val	165	170	175	
Glu	Lys	Ala	Pro	Leu	Pro	Pro	Val	Ser	Ser	Asp	Ile	Ala	Arg	Ala	Ala	180	185	190	
Ser	Ala	Gln	Arg	Glu	Leu	Phe	Asp	Asp	Leu	Ser	Ala	Val	Ser	Gln	Glu	195	200	205	
Leu	Glu	Glu	Ile	Leu	Leu	Ala	Val	Thr	Val	Glu	Trp	Pro	Lys	Gln	Glu	210	215	220	
Ile	Trp	Thr	His	Pro	Ile	Gly	Met	Phe	Phe	Asn	Ala	Ser	Arg	Arg	Leu	225	230	235	240
Leu	Thr	Val	Leu	Arg	Gln	Gln	Ala	Gln	Ala	Asp	Cys	His	Gln	Gly	Thr	245	250	255	
Leu	Asp	Glu	Cys	Leu	Arg	Thr	Lys	Asn	Leu	Phe	Thr	Ala	Val	His	Cys	260	265	270	
Tyr	Ile	Leu	Asn	Val	Arg	Ile	Leu	Thr	Ala	Ile	Ser	Glu	Leu	Leu	Leu	275	280	285	
Ser	Gln	Ile	Arg	Arg	Thr	Gln	Asn	Ser	His	Met	Ser	Pro	Leu	Glu	Gly	290	295	300	
Ser	Arg	Ser	Gln	Ser	Pro	Ser	Arg	Asp	Asp	Thr	Ser	Ser	Ser	Ser	Gly	305	310	315	320
His	Ser	Cys	Val	Asp	Thr	Ile	Pro	Phe	Phe	Ser	Glu	Asn	Leu	Pro	Ile	325	330	335	
Gly	Glu	Leu	Phe	Ser	Tyr	Val	Asp	Pro	Leu	Thr	His	Ala	Leu	Phe	Ser	340	345	350	
Ala	Cys	Thr	Thr	Leu	His	Val	Gly	Val	Gln	Leu	Leu	Arg	Glu	Tyr	Glu	355	360	365	
Ile	Thr	Leu	Gly	Ile	His	Ser	Ala	Gln	Gly	Ile	Ala	Ala	Ser	Ile	Ser	370	375	380	
Met	Ser	Gly	Glu	Pro	Gly	Glu	Asp	Ile	Ala	Arg	Thr	Gly	Ala	Thr	Asn	385	390	395	400
Ser	Ala	Arg	Cys	Glu	Glu	Gln	Pro	Thr	Thr	Pro	Ala	Ala	Arg	Val	Leu	405	410	415	
Phe	Met	Phe	Leu	Ser	Asp	Glu	Gly	Ala	Phe	Gln	Glu	Ala	Lys	Ser	Ala	420	425	430	
Gly	Ser	Arg	Gly	Arg	Thr	Ile	Ala	Ala	Leu	Arg	Arg	Cys	Tyr	Glu	Asp	435	440	445	
Ile	Phe	Ser	Leu	Ala	Arg	Lys	His	Lys	His	Gly	Met	Leu	Arg	Asp	Leu				

450
Asn Asn Ile Pro Pro
465

455

460

<210> 62
<211> 469
<212> PRT
<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 62

Met	Ala	Ala	Asp	Gln	Gly	Ile	Phe	Thr	Asn	Ser	Val	Thr	Leu	Ser	Pro
1				5					10					15	
Val	Glu	Gly	Ser	Arg	Thr	Gly	Gly	Thr	Leu	Pro	Arg	Arg	Ala	Phe	Arg
			20					25					30		
Arg	Ser	Cys	Asp	Arg	Cys	His	Ala	Arg	Lys	Ile	Lys	Cys	Thr	Gly	Asn
		35					40					45			
Lys	Glu	Val	Thr	Gly	Arg	Ala	Pro	Cys	Gln	Arg	Cys	Gln	Gln	Ala	Gly
	50					55					60				
Leu	Arg	Cys	Val	Tyr	Ser	Glu	Arg	Cys	Pro	Lys	Arg	Lys	Leu	Arg	Gln
65					70					75					80
Ser	Arg	Ala	Ala	Asp	Leu	Val	Ser	Ala	Asp	Pro	Asp	Pro	Cys	Leu	His
				85					90					95	
Met	Ser	Ser	Pro	Pro	Val	Pro	Ser	Gln	Ser	Leu	Pro	Leu	Asp	Val	Ser
			100					105					110		
Glu	Ser	His	Ser	Ser	Asn	Thr	Ser	Arg	Gln	Phe	Leu	Asp	Pro	Pro	Asp
		115					120					125			
Ser	Tyr	Asp	Trp	Ser	Trp	Thr	Ser	Ile	Gly	Thr	Asp	Glu	Ala	Ile	Asp
	130					135					140				
Thr	Asp	Cys	Trp	Gly	Leu	Ser	Gln	Cys	Asp	Gly	Gly	Phe	Ser	Cys	Gln
145					150					155					160
Leu	Glu	Pro	Thr	Leu	Pro	Asp	Leu	Pro	Ser	Pro	Phe	Glu	Ser	Thr	Val
				165				170						175	
Glu	Lys	Ala	Pro	Leu	Pro	Pro	Val	Ser	Ser	Asp	Ile	Ala	Arg	Ala	Ala
			180					185					190		
Ser	Ala	Gln	Arg	Glu	Leu	Phe	Asp	Asp	Leu	Ser	Ala	Val	Ser	Gln	Glu
		195					200					205			
Leu	Glu	Glu	Ile	Leu	Leu	Ala	Val	Thr	Val	Glu	Trp	Pro	Lys	Gln	Glu
	210					215					220				
Ile	Trp	Thr	His	Pro	Ile	Gly	Met	Phe	Phe	Asn	Ala	Ser	Arg	Arg	Leu
225					230					235					240
Leu	Thr	Val	Leu	Arg	Gln	Gln	Ala	Gln	Ala	Asp	Cys	His	Gln	Gly	Thr
				245				250						255	
Leu	Asp	Glu	Cys	Leu	Arg	Thr	Lys	Asn	Leu	Phe	Thr	Ala	Val	His	Cys
			260					265					270		
Tyr	Ile	Leu	Asn	Val	Arg	Ile	Leu	Thr	Ala	Ile	Ser	Glu	Leu	Leu	Leu
		275					280					285			
Ser	Gln	Ile	Arg	Arg	Ile	Gln	Asn	Ser	His	Met	Ser	Pro	Leu	Glu	Gly
	290					295					300				
Ser	Arg	Ser	Gln	Ser	Leu	Ser	Arg	Asp	Asp	Thr	Ser	Ser	Ser	Ser	Gly
305					310					315					320
His	Ser	Ser	Val	Asp	Thr	Ile	Pro	Phe	Phe	Ser	Glu	Asn	Leu	Pro	Ile
				325					330					335	
Asp	Glu	Leu	Phe	Ser	Tyr	Val	Asp	Pro	Leu	Thr	His	Ala	Leu	Phe	Ser

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          340          345          350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
          355          360          365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
          370          375          380
Met Ser Gly Glu Leu Gly Glu Asp Ile Val Arg Thr Gly Ala Thr Asn
385          390          395          400
Ser Ala Arg Cys Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
          405          410          415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
          420          425          430
Gly Ser Arg Ser Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
          435          440          445
Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
          450          455          460
Asn Asn Ile Pro Pro
465

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<210> 63

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 63

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Met Ala Ala Asp Gln Gly Ile Phe Thr Asn Ser Val Thr Leu Ser Pro
1          5          10          15
Val Glu Gly Ser Arg Thr Gly Gly Thr Leu Pro Arg Arg Ala Phe Arg
          20          25          30
Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
          35          40          45
Lys Glu Val Asn Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
          50          55          60
Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg Gln
65          70          75          80
Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
          85          90          95
Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Ile Ser
          100          105          110
Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
          115          120          125
Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Ile Asp Glu Ala Ile Asp
          130          135          140
Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
145          150          155          160
Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
          165          170          175
Glu Lys Ala Pro Leu Pro Pro Ile Ser Ser Asp Ile Ala Arg Ala Ala
          180          185          190
Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
          195          200          205
Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
          210          215          220
Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu

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225          230          235          240
Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
          245          250          255
Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
          260          265          270
Tyr Ile Leu Asn Val Arg Ile Leu Ala Ala Ile Ser Glu Leu Leu Leu
          275          280          285
Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
          290          295          300
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
305          310          315          320
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
          325          330          335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
          340          345          350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
          355          360          365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
          370          375          380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
385          390          395          400
Ser Ala Arg Cys Glu Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
          405          410          415
Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
          420          425          430
Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
          435          440          445
Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
          450          455          460
Asn Asn Ile Pro Pro
465

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<210> 64

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 64

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Met Ala Ala Glu Gln Gly Ile Phe Thr Asn Ser Val Thr Leu Ser Pro
1          5          10          15
Val Glu Gly Ser Arg Thr Gly Gly Thr Leu Pro Arg Arg Ala Phe Arg
          20          25          30
Arg Ser Cys Asp Arg Cys His Ala Arg Lys Ile Lys Cys Thr Gly Asn
          35          40          45
Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
          50          55          60
Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg Gln
65          70          75          80
Ser Arg Ala Ala Asp Leu Ile Ser Ala Asp Pro Asp Pro Cys Leu His
          85          90          95
Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Glu Val Ser
          100          105          110
Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp

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      115              120              125
Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Lys Ala Ile Asp
      130              135              140
Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
145              150              155              160
Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
      165              170              175
Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Thr Arg Ala Ala
      180              185              190
Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
      195              200              205
Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
      210              215              220
Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
225              230              235              240
Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
      245              250              255
Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
      260              265              270
Tyr Ile Leu Asp Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
      275              280              285
Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
      290              295              300
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
305              310              315              320
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
      325              330              335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Arg His Ala Leu Phe Ser
      340              345              350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Ile Glu
      355              360              365
Ile Thr Leu Gly Val His Ser Ala Arg Gly Ile Ala Ala Ser Ile Ser
      370              375              380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
385              390              395              400
Ser Ala Arg Cys Glu Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
      405              410              415
Phe Met Phe Leu Ser Asp Glu Gly Thr Phe Gln Glu Ala Lys Ser Ala
      420              425              430
Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
      435              440              445
Ile Phe Ser Leu Ala Arg Lys His Lys His Gly Met Leu Arg Asp Leu
      450              455              460
Asn Asn Ile Pro Pro
465

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<210> 65

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of variants of the lovE Gene

<400> 65

Met Ala Ala Asp Gln Gly Ile Phe Thr Asn Ser Val Thr Leu Ser Pro

1				5				10					15		
Val	Glu	Gly	Ser	Arg	Thr	Gly	Gly	Thr	Leu	Pro	Arg	Arg	Ala	Phe	Arg
			20					25					30		
Arg	Ser	Cys	Asp	Arg	Cys	His	Ala	Gln	Lys	Ile	Lys	Cys	Thr	Gly	Asn
		35					40					45			
Lys	Glu	Val	Thr	Gly	Arg	Ala	Pro	Cys	Gln	Arg	Cys	Gln	Gln	Ala	Gly
	50					55					60				
Leu	Arg	Cys	Val	Tyr	Ser	Glu	Arg	Cys	Pro	Lys	Arg	Lys	Leu	Arg	Gln
65					70					75					80
Ser	Arg	Ala	Ala	Asp	Leu	Val	Ser	Ala	Asp	Pro	Asp	Pro	Cys	Leu	His
				85					90					95	
Met	Ser	Ser	Pro	Pro	Val	Pro	Ser	Gln	Ser	Leu	Pro	Leu	Asp	Val	Ser
			100					105					110		
Glu	Ser	His	Ser	Ser	Asn	Thr	Ser	Arg	Gln	Phe	Leu	Asp	Pro	Pro	Asp
		115					120					125			
Ser	Tyr	Asn	Trp	Leu	Trp	Thr	Ser	Ile	Gly	Thr	Asp	Glu	Ala	Ile	Asp
	130					135					140				
Thr	Asp	Cys	Trp	Gly	Leu	Ser	Gln	Cys	Asp	Gly	Gly	Phe	Ser	Cys	Gln
145					150					155					160
Leu	Glu	Pro	Thr	Leu	Pro	Asp	Leu	Pro	Ser	Pro	Phe	Glu	Ser	Thr	Val
				165					170					175	
Glu	Lys	Ala	Pro	Leu	Pro	Pro	Val	Ser	Ser	Asp	Ile	Ala	Arg	Ala	Ala
			180					185					190		
Ser	Ala	Gln	Arg	Glu	Leu	Phe	Asp	Asp	Leu	Ser	Ala	Val	Ser	Gln	Glu
	195						200					205			
Leu	Glu	Glu	Ile	Leu	Leu	Ala	Val	Thr	Val	Glu	Trp	Pro	Lys	Gln	Glu
	210					215				220					
Ile	Trp	Thr	His	Pro	Ile	Gly	Met	Phe	Phe	Asn	Ala	Ser	Arg	Arg	Leu
225					230					235					240
Leu	Thr	Val	Leu	Arg	Gln	Gln	Ala	Gln	Ala	Asp	Cys	His	Gln	Gly	Thr
				245					250					255	
Leu	Asp	Glu	Cys	Leu	Arg	Thr	Lys	Asn	Leu	Phe	Thr	Ala	Val	His	Cys
			260					265					270		
Tyr	Ile	Leu	Asn	Val	Arg	Ile	Leu	Thr	Ala	Ile	Ser	Glu	Leu	Leu	Leu
	275						280					285			
Ser	Gln	Ile	Arg	Arg	Thr	Gln	Asn	Ser	His	Met	Ser	Pro	Leu	Glu	Gly
	290					295					300				
Ser	Arg	Ser	Gln	Ser	Pro	Ser	Gly	Asp	Asp	Thr	Ser	Ser	Ser	Ser	Gly
305					310					315					320
His	Ser	Ser	Val	Asp	Thr	Ile	Pro	Phe	Phe	Ser	Glu	Asn	Leu	Pro	Ile
				325					330					335	
Gly	Glu	Leu	Phe	Ser	Tyr	Val	Asp	Pro	Leu	Thr	His	Ala	Leu	Phe	Ser
			340					345					350		
Ala	Cys	Thr	Thr	Leu	His	Val	Gly	Val	Gln	Leu	Leu	Arg	Glu	Asn	Glu
		355					360					365			
Ile	Thr	Leu	Gly	Val	His	Ser	Ala	Gln	Gly	Ile	Ala	Ala	Ser	Ile	Ser
	370					375					380				
Met	Ser	Gly	Glu	Pro	Gly	Glu	Asp	Ile	Ala	Arg	Thr	Gly	Ala	Thr	Asn
385					390					395					400
Ser	Ala	Arg	Cys	Glu	Glu	Gln	Pro	Thr	Thr	Pro	Ala	Ala	Arg	Val	Leu
				405					410					415	
Phe	Met	Phe	Leu	Ser	Asp	Glu	Gly	Ala	Phe	Gln	Glu	Gly	Lys	Ser	Ala
			420					425					430		
Gly	Ser	Arg	Gly	Arg	Thr	Ile	Ala	Ala	Leu	Arg	Arg	Cys	Tyr	Glu	Asp
		435					440					445			
Ile	Phe	Ser	Leu	Ala	Arg	Lys	His	Lys	His	Gly	Met	Leu	Arg	Asp	Leu
	450					455					460				

Asn Asn Ile Pro Pro
465

<210> 66
<211> 1410
<212> DNA
<213> Artificial Sequence

<220>
<223> DNA sequence of variants of the lovE Gene

<400> 66
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caaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcggttg 180
cagcaggctg gacttcgatg cgtctacagt gagcgatgcc ccaagcgcaa gctacgcaa 240
tccagggcag cggatctcgt ctctgctgac ccagatccct gcttgacat gtccctcgct 300
ccagtgccct cacagagctt gccgctagac gtatccgagt cgcattcctc aaatacctcc 360
cggcagtttc ttgatccacc ggacagctac gactggtcgt ggacctcgat tggcactgac 420
gaggctattg aactgactg ctgggggctg tcccaatgtg atggaggctt cagctgtcag 480
ttagagccaa cgctgccgga tctaccttcg cccttcgagt ctacggttga aaaagctccg 540
ttgccaccgg tatcgagcga cattgctcgt gcggccagt cgcaacgaga gcttttcgat 600
gacctgtcgg cgggtgtcga ggaactggaa gagatccctc tggccgtgac ggtagaatgg 660
ccgaagcagg aaatctggac ccattccatc ggaatgtttt tcaatgcgtc acgacggctt 720
cttactgtcc tgcgccaaca agcgcaggcc gactgccgtc aaggcacact agacgaatgt 780
ttacggacca agaacctctt tacggcagta cactgttaca tattgaatgt gcggattttg 840
accgccatat cggagttgct cctgtcgcaa attaggcgga cccagaacag ccatatgagc 900
ccactggaag ggagtcgac ccagtcgccg agcagagacg acaccagcag cagcagcggc 960
cacagcagtg ttgacacat acccttcttt agcgagaacc tccctatttg tgagctgttc 1020
ccctatgttg accccctgac acacgcccta ttctcggtt gcactacgtt acatgttggg 1080
gtacaattgc tgcgtgagaa tgagattact ctgggagtag actccgcca ggcgattgca 1140
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agtgatgaag gggctttcca ggaggcaaag tctgctggtt cccgaggtcg aaccatcgca 1320
gcactgcgac gatgctatga ggatatcttt tccctcgccc gcaaacacaa acatggcatg 1380
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<210> 67
<211> 1410
<212> DNA
<213> Artificial Sequence

<220>
<223> DNA sequence of variants of the lovE Gene

<400> 67
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cgcaccggtg gaacattacc ccgccgtgca ttccgacgct cttgtgatcg gtgtcatgca 120
caaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcggttg 180
cagcaggctg gacttcgatg cgtctacagt gagcgatgcc ccaagcgcaa gctacgcaa 240
tccagggcag cggatctcgt ctctgctgac ccagatccct gcttgacat gtccctcgct 300
ccagtgccct cacagagctt gccgctagac gtatccgagt cgcattcctc aaatacctcc 360
tggcaatttc ttgatccacc ggacagctac gactggttgt ggacctcgat tggcactgac 420
gaggctattg aactgactg ctgggggctg tcccaatgtg atggaggctt cagctgtcag 480
ttagagccaa cgctgccgga tctaccttcg cccttcgagt ctacggttga aaaagctccg 540
ttgccaccgg tatcgagcga cattgctcgt gcggccagt cgcaacgaga gcttttcgat 600


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gacctgtcgg cgggtgtcgca ggaactggaa gagatccttc tggccgtgac ggtagagtgg 660
ccgaagcagg aaatctggac ccatcccatc ggaatgtttt tcaatgcgtc acgacggctt 720
cttactgtcc tgcgccaaca agcgcaggcc gactgccatc aaggcacact agacgaatgt 780
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accgccatat cggagtgtgt cctgtcgcaa attaggcgga cccagaacag ccatatgagc 900
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cacggcagtg ttgacaccat acccttcttt agcgagaacc tccctatttg tgagctgttc 1020
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tccgcaagat gcgaggagca gccgaccact ccagcggtc gggttttgtt catgttcttg 1260
agtgatgaag gggctttcca ggaggcaaag tctgctggtt cccgaggtcg aaccatcgca 1320
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ctcagagacc tcaacaatat tcctccatga 1410

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<210> 68

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 68

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caaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcgttgc 180
cagcaggctg gacttcgatg cgtctacagt gagcgacgcc ccaagcgcaa gctacgcaa 240
tccagggtag cggatctcgt ctctgctgac ccagatccct gcttgacat gtcctcgcc 300
ccagtcacct cacagagctt gccgctagac gtatccgagt cgcattcctc aaatacctcc 360
cggcaatttc ttgatccacc ggacagctac gactggtcgt ggatctcgat tggcactgac 420
gaggctattg aactgactg ctgggggctg tcccaatgtg atggaggctt cagctgtcag 480
ttagagccaa cgctgccgga tctaccttcg cccttcgagt ctacggttga aaaagctccg 540
ttgccaccgg tatcgagcga cattgctcgt gcggccagtg cgcaacgaga gcttttcgat 600
gacctgtcgg cgggtgtcgca ggaactggaa gagatccttc tggccgtgac ggtagaatgg 660
ccgaagcagg aaatctggac ccatcccatc ggaatgtttt tcaatgcgtc acgacggctt 720
cttactgtcc tgcgccaaca agcgcaggcc gactgccatc aaggcacact agacgaatgt 780
ttacggacca agaacctctt tacggcagta cactgttaca tattgaatgt gcggattttg 840
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ccactggaag ggagtcgac ccagtcgccc agcagagacg acaccagcag cagcagcggc 960
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tccgcaagat gcgaggagca gccgaccact ccagcggtc gggttttgtt catgttcttg 1260
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gactgcgac gatgctatga ggatatcttt tccctcgccc gcaaacacaa acatggcatg 1380
ctcagagacc tcaacaatat tcctccatga 1410

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<210> 69

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 69

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cgccaccggtg gaacattacc ccgccgtgca ttccgacgct cttgtgatcg gtgtcatgca 120
caaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcggttg 180
cagcaggctg gacttcgatg cgtctacagt gaggcagccc ccaagcgcaa gctacgcaa 240
tccagggcag cggatctcgt ctctgctgac ccagatccct gcttgacat gtccctgcct 300
ccagtgcctt cacagagctt gccgctagac gtatccgagt cgcattcctc aaatacctcc 360
cggcaatttc ttgatccacc ggacagctac gactggtcgt ggacctcgat tggcactgac 420
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ctcagagacc tcaacaatat tcctccatga 1410

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<210> 70

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 70

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atggctgcag atcaaggtat attcacgaac tcggtcactc tctcgccagt ggaggggttca 60
cgccaccggtg gaacattacc ccgccgtgca ttccgacgct cttgtgatcg gtgtcatgca 120
caaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcggttg 180
cagcaggctg gacttcgatg cgtctacagt gaggcagccc ccaagcgcaa gctacgcaa 240
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cggcaatttc ttgatccacc ggacagctac gactggtcgt ggacctcgat tggcactgac 420
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gcactgcgac gatgctatga ggatatcttt tccctcgccc gcaaacacaa acatggcatg 1380
ctcagagacc tcaacaatat tcctccatga 1410
```

<210> 71

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 71

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cgcaccggtg gaacattacc ccgccgtgca ttccgacgct cttgtgatcg gtgtcatgca 120
caaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcgttgc 180
cagcaggctg gacttcgatg cgtctacagt gagcgatgcc ccaagcgcaa gctacgcaa 240
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cggcaatttc ttgatccacc ggacagctac gactggctcg ggacctcgat tggcactgac 420
gaggctattg aactgactg ctgggggctg tcccaatatg atggaggctt cagctgtcag 480
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gcactgcgac gatgctatga ggatatcttt tccctcgccc gcaaacacaa acatggcatg 1380
ctcagagacc tcaacaatat tcctccatga 1410
```

<210> 72

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 72

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cgcaccggtg gaacattacc ccgccgtgca ttccgacgct cttgtgatcg gtgtcatgca 120
caaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcgttgc 180
cagcaggctg gacttcgatg cgtctacagt gagcgacgcc ccaagcgcaa gctacgcaa 240
tccagggcag cggatctcgt ctctgctgac ccagatccct gcttgacat gtcctcgct 300
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cggcaatttc ttgatccacc ggacagctac gactggctcg ggacctcgat tggcactgac 420
gaggctattg aactgactg ctgggggctg tcccaatatg atggaggctt cagctgtcag 480
ttagagccaa cgctgccgga tctaccttcg cccttcgagt ctacggttga aaaagctccg 540
ttgccaccgg tatcgagcga cattgctcgt gcggccagtg cgcaacgaga gcttttcgat 600
gacctgtcgg cgggtgtcga ggaactggaa gagatccttc tggccgtgac ggtagaatgg 660
```

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ccgaagcagg aaatctggac ccatcccatc ggaatgtttt tcaatgcgtc acgacggctt 720
cttactgtcc tgcgccaaca agcgcaggcc gactgccatc aaggcgact agacgaatgt 780
ttacggacca agaacctctt tacggcagta cactgttaca tattgaatgt gcggattttg 840
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gcactgcgac gatgctatga ggatatcttt tccctcgccc gcaaacacaa acatggcatg 1380
ctcagagacc tcaacagtat tcctccatga 1410

```

<210> 73

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 73

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cgcaccggtg gaacattacc ccgccgtgca ttccgacgtt cttgtgatcg gtgtcatgca 120
caaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcgttgc 180
cagcaggctg gacttcgatg cgtctacagt gagcgacgcc ccaagcgcaa gctacgcaa 240
tccagggcag cggatctcgt ctctgctgac ccagatccct gcttgacat gtcctcgct 300
ccagtgcctt cacagagctt gccgctagac gtatccgagt cgcattcctc aaatacctcc 360
cggcaatttc ttgatccacc ggacagctac gactggctgt ggacctcgat tggcactgac 420
gtggctattg aactgactg ctgggggctg tcccaatgtg atggaggctt cagctgtcag 480
ttagagccaa cgctgccgga tctaccttcg cccttcgagt ctacggttga aaaagctccg 540
ttgccaccgg tatcgagcga cattgctcgt gcggccagtg cgcaacgaga gcttttcgat 600
gacctgtcgg cgggtgtcga ggaactggaa gagatccttc tggccgtgac ggtagaatgg 660
ccgaagcagg aaatctggac ccatcccatc ggaatgtttt tcaatgcgtc acgacggctt 720
cttactgtcc tgcgccaaca agcgcaggcc gactgccatc aaggcacact agacgaatgt 780
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gcactgcgac gatgctatga ggatatcttt tccctcgccc gcaaacacaa acatggcatg 1380
ctcagagacc tcaacaatat tcctccatga 1410

```

<210> 74

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 74

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cgcaccgggtg gaacattacc ccgccgtgca ttccgacgct cttgtgatcg gtgtcatgca 120
caaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcgttgc 180
cagcaggctg gacttcgatg cgtctacagt gagcgacgcc ccaagcgcaa gctacgccaa 240
tccagggcag cggatctcgt ttctgctgac ccagatccct gcttgcacat gtcctcgcc 300
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cggcaatttc ttgatccacc ggacagctac gactggtcgt ggacctcgat tggcactgac 420
gaggctattg aactgactg ctgggggctg tcccaatgtg atggaggctt cagctgtcag 480
ttagagccaa cgctgccgga tctaccttcg cccttcgagt ctacggttga aaaagctccg 540
ttgccaccgg tatcgagcga cattgctcgt gcggccagtg cgcaacgaga gcttttcgat 600
gacctgtcgg cgggtgtcga ggaactggaa gagatccttc tggccgtgac ggtagaatgg 660
ccgaagcagg aaatctggac ccatcccatc ggaatgtttt tcaatgcgtc acgacggctt 720
cttactgtcc tgcgccaaca agcgaggcc gactgccatc aaggcacact agacgaatgt 780
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gtacaattgc tgcgtgagaa tgagattact ctgggagtag actccgcccc gggcatttga 1140
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gcactgcgac gatgctatga ggatatcttt tccctcgccc gcaaacacaa acatggcatg 1380
ctcagagacc tcaacaatat tcctccatga 1410

```

<210> 75

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 75

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atggctgcag atcaaggtat attcacgaac tcggtcactc tctcgccagt ggaggggttca 60
cgcaccgggtg gaacattacc ccgccgtgca ttccgacgct cttgtgatcg gtgtcatgca 120
aaaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcgttgc 180
cagcaggctg gacttcgatg cgtctacagt gagcgatgcc ccaagcgcaa gctacgccaa 240
tccagggcag cggatctcgt ctctgctgac ccagatccct gcttgcacat gtcctcgcc 300
ccagtgccct cacagagctt gccgctagac gtatccgagt cgcattcctc aaatacctcc 360
cggcaatttc ttgatccacc ggacagctac gactggtcgt ggacctcgat tggcactgac 420
gaggctattg aactgactg ctgggggctg tcccaatgtg atggaggctt cagctgtcag 480
ttagagccaa cgctgccgga tctaccttcg cccttcgagt ctacggttga aaaagctccg 540
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gacctgtcgg cgggtgtcga ggaactggaa gagatccttc tggccgtgac ggtagaatgg 660
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agtgatgaag gggctttcca ggaggcaaag tctgctggtt cccgaggtcg aaccatcgca 1320
gcactgcgac gatgctatga ggatatcttt tccctcgccc gcaaacacaa acatggcatg 1380

```

ctcagagacc tcaacaatat tcctccatga

1410

<210> 76

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 76

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atggctgcag atcaaggtat attcatgaac tcggctcactc tctctgcagt ggaggggttca 60
cgcaccagtg gaacattacc ccgccgtgca ttccgacgct cttgtgatcg gtgtcatgca 120
aaaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcggttg 180
cagcaggctg gacttcgatg cgtctacagt gagcgatgcc ccaagcgcaa gctacgcca 240
tccagggcag cggatctcgt ctctgctgac ccagatccct gcttgacat gtccctgcct 300
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gaggctattg acactgactg ctgggggctg tcccaatgtg atggaggctt cagctgtcag 480
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gactgcgac gatgctatga ggatatcttt tccctcgccc gcaaacacaa acatggcatg 1380
ctcagagacc tcaacaatat tcctccatga 1410

```

<210> 77

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 77

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cacaccggtg gaacattacc ccgccgtgca ttccgacgcg cttgtgatcg gtgtcatgca 120
caaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcggttg 180
cagcaggctg gacttcgatg cgtctacagt gagcgatgcc ccaagcgcaa gctacgcca 240
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cggcaatttc ttgatccacc ggacagctac gactggctcg ggacctcgat tggcactgac 420
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gacctgtcgg cgggtgtcga ggaactggaa gagatccttc tggccgtgac ggtagaatgg 660
ccgaagcagg aaatctggac ccatcccatc ggaatgtttt tcaatgcgtc acgacggctt 720

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cttactgtcc tgcgccaaca agcgcaggcc gactgccatc aaggcacact agacgaatgt 780
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gtactgcgac gaagctatga ggatatcttt tccctcgccc gcaaacacaa acatggcatg 1380
ctcagagacc tcaacaatat tccttcatga 1410

```

<210> 78

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 78

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cgcaccggtg gaacattacc ccgccgtgca ctccgacgct cttgtgatcg gtgtcatgca 120
caaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcgttgc 180
cagcaggctg gacttcgatg cgtctacagt gacgatgcc ccaagcgcaa gctacgcca 240
tccaggcgat cggatctcgt ctctgctgac ccagatccct gcttgacat gtcctcgcct 300
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<210> 79

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 79

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atggctgcag atcaaggtat attcacgaac tcggtcactc tctcgccagt ggagggttca 60

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ctcagagacc tcaacaatat tcctccatga 1410

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<210> 80

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 80

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ctcagagacc tcaacaatat tcctccatga 1410

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<210> 81
 <211> 1410
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> DNA sequence of variants of the lovE Gene

<400> 81
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 caaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcgttgc 180
 cagcaggctg gacttcgatg cgtctacagt gagcgatgcc ccaagcgcaa gttacgcaa 240
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 tcagtgccct cacagagctt gccgctagac gtatccgagt cgcattcctc aaatacctcc 360
 cggcaatttc ttgatccacc ggacagctac gactggtcgt ggacctcgat ttgactgac 420
 gaggctattg acactgactg ctgggggctg tcccaacgtg atggaggctt cagctctcag 480
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 ttgccaccgg tatcgagcga cattgctcgt gcggccagtgc cgcaacgaga gcttttcgat 600
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 agtgatgaag gggctttcca ggaggcaaag tctgctggtt cccgaggtcg aaccatcgca 1320
 gcaactgcgac gatgctatga ggatatcttt tccctcgccc gcaaacacaa acatggcatg 1380
 ctcagagacc tcaacaatat tcctccatga 1410

<210> 82
 <211> 1410
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> DNA sequence of variants of the lovE Gene

<400> 82
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 cgcaccgggtg gaacattacc ccgccgtgca ttccgacgct cttgtgatcg gtgtcatgca 120
 caaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcgttgc 180
 cagcaggctg gacttcgatg cgtctacagt gagcgatgcc ccaagcgcaa gttacgcaa 240
 tccagggcag cggatctcgt ctctgctgac ccagatccct gcttgcacat gtcctcgcct 300
 ccagtgcctt cacagagttt gccgctagac gtatccgagt cgcattcctc aaatacctcc 360
 cggcaatttc ttgatccacc ggacagctac gactggtcgt ggacctcgat ttgactgac 420
 gaggctattg acactgactg ctgggggctg tcccaatgtg atggaggctt cagctgtcag 480
 ttagagccaa cgctgccgga tctaccttcg cccttcgagt ctacggttga aaaagctccg 540
 ttgccaccgg tatcgagcga cattgctcgt gcggccagtgc cgcaacgaga gcttttcgat 600
 gacctgtcgg cgggtgtcgca ggaactggaa gagatccttc tggccgtgac ggtagaatgg 660
 ccgaagcagg aaatctggac ccattccatc ggaatgtttt tcaatgcgtc acgacggctt 720
 cttactgtcc tgcgccaaca agcgcaggcc gactgccatc aaggcacact agacgaatgt 780
 ttacggacca agaacctctt tacggcagta cactgttaca tattgaatgt gcggattttg 840

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accgccatat cgaggttgct cctgtcgcaa attagcgga cccagaacag ccatatgagc 900
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ctcagagacc tcaacaatat tcctccatga 1410

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<210> 83

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 83

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cgaccgggtg gaacattacc ccgccgtgca ttccgacgct cttgtgatcg gtgtcatgca 120
cgaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcgttgc 180
cagcaggctg gacttcgatg cgtctacagt gagcgatgcc ccaagcgcaa gctacgccc 240
tccagggcag cggatctcgt ctctgctgac ccagatccct gcttgacatc gtcctcgcc 300
ccagtgcctt cacagagctt gccgctagac gtatccgagt cgcattcctc aaatacctcc 360
cggcaatttc ttgatccacc ggacagctac gactggctcg ggacctcgat tggcactgac 420
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gcactgcgac gatgctatga ggatatcttt tccctcgccc gcaaacacaa acatggcatg 1380
ctcagagacc tcaacaatat tcctccatga 1410

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<210> 84

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 84

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cgaccgggtg gaacattacc ccgccgtgca ttccgacgct cttgtgatcg gtgtcatgca 120
caaaagatca aatgtactgg aaataaggag gttattggcc gtgctccctg tcagcgttgc 180

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cagcaggctg gacttcgatg cgtatacagt gagcgatgcc ccaagcgcaa gctacgccaa 240
tccagggcag cggatctcgt ctctgctgac ccagatccct gcttgacacat gtcctcgcct 300
caagtgccct cacagagctt gtcgctagac atatccgagt cgcattcctc aaatacctcc 360
cggcaatttc ttgatccacc ggacagctac gactggctcg ggacctcgat tggcactgac 420
gaggctattg acactgactg ctgggggctg tcccaatgtg atggaggctt cagctgtcag 480
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ctcagagacc tcaacaatat tcctccatga 1410

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<210> 85

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 85

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cgcaccgggtg gaacattacc ccgccgtgca ttccgacgct cttgtgatcg gtgtcatgca 120
caaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcggttg 180
cagcaggctg gacttcgatg cgtctacagt gagcgatgcc ccaagcgcaa gctacgccaa 240
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gcaactgcgac gatgctatga ggatatcttt tccctcgccc gcaaacacaa acatggcatg 1380
ctcagagacc tcaacaatat tcctccatga 1410

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<210> 86

<211> 1410
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> DNA sequence of variants of the lovE Gene

<400> 86
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 cgcaccggtg gaacattacc ccgccgtgca ttccgacgct cttgtgatcg gtgtcatgca 120
 caaaagatca aatgtatttg aaataaggag gttactggcc gtgctccctg tcagcgttgc 180
 caacgggctg gacttcgatg cgtctacagt gagcgatgcc ccaagcgag gctacgcaa 240
 tccagggcag cggatctcgt ctctgctgac ccagatccct gcttgacat gtccctgcct 300
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 gaggtatttg aactgactg ctgggggctg tcccaatgtg atggaggctt cagctgtcag 480
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 ttgccaccgg tatcgagcga cattgctcgt gcggccagtg cgcaacgaga gcttttcgat 600
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 gactgcgac gatgctatga ggatatcttt tccctcgccc gcaaacacaa acatggcatg 1380
 ctcagagatc tcaacaatat tcctccatga 1410

<210> 87
 <211> 1410
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> DNA sequence of variants of the lovE Gene

<400> 87
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 cgcaccggtg gaacattacc ccgccgtgca ttccgacgct cttgtgatcg gtgtcatgca 120
 cgaaagatca aatgtacttg aaataaggag gttactggcc gtgctccctg tcagcgttgc 180
 cagcaagctg gacttcgatg cgtctatagt gagcgatgcc ccaagcgcaa gctacgcaa 240
 tccagggcag cggatctcgt ctctgctgac ccagatccct gcttgacat gtccctgcct 300
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<210> 88
 <211> 1410
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> DNA sequence of variants of the lovE Gene

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<210> 89
 <211> 1410
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> DNA sequence of variants of the lovE Gene

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cgaaagatca aatgtactgg aaataaggag gttactggcc gtgctccctg tcagcgttgc 180
cagcaggctg gacttcgatg tgtctacagt gagcgatgcc ccaagcgcaa gctacgcaa 240

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cggcaatttc ttgatccacc ggacagctac gactggctgt ggacctcgat tggcactgac 420
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<210> 90

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> DNA sequence of variants of the lovE Gene

<400> 90

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<210> 91

<211> 469

<212> PRT

<213> Artificial Sequence

<220>

<223> Wild-type lovE amino acid sequence

<400> 91

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Arg Ser Cys Asp Arg Cys His Ala Gln Lys Ile Lys Cys Thr Gly Asn
          35           40           45
Lys Glu Val Thr Gly Arg Ala Pro Cys Gln Arg Cys Gln Gln Ala Gly
          50           55           60
Leu Arg Cys Val Tyr Ser Glu Arg Cys Pro Lys Arg Lys Leu Arg Gln
65           70           75           80
Ser Arg Ala Ala Asp Leu Val Ser Ala Asp Pro Asp Pro Cys Leu His
          85           90           95
Met Ser Ser Pro Pro Val Pro Ser Gln Ser Leu Pro Leu Asp Val Ser
          100          105          110
Glu Ser His Ser Ser Asn Thr Ser Arg Gln Phe Leu Asp Pro Pro Asp
          115          120          125
Ser Tyr Asp Trp Ser Trp Thr Ser Ile Gly Thr Asp Glu Ala Ile Asp
130          135          140
Thr Asp Cys Trp Gly Leu Ser Gln Cys Asp Gly Gly Phe Ser Cys Gln
145          150          155          160
Leu Glu Pro Thr Leu Pro Asp Leu Pro Ser Pro Phe Glu Ser Thr Val
          165          170          175
Glu Lys Ala Pro Leu Pro Pro Val Ser Ser Asp Ile Ala Arg Ala Ala
          180          185          190
Ser Ala Gln Arg Glu Leu Phe Asp Asp Leu Ser Ala Val Ser Gln Glu
195          200          205
Leu Glu Glu Ile Leu Leu Ala Val Thr Val Glu Trp Pro Lys Gln Glu
210          215          220
Ile Trp Thr His Pro Ile Gly Met Phe Phe Asn Ala Ser Arg Arg Leu
225          230          235          240
Leu Thr Val Leu Arg Gln Gln Ala Gln Ala Asp Cys His Gln Gly Thr
          245          250          255
Leu Asp Glu Cys Leu Arg Thr Lys Asn Leu Phe Thr Ala Val His Cys
          260          265          270
Tyr Ile Leu Asn Val Arg Ile Leu Thr Ala Ile Ser Glu Leu Leu Leu
          275          280          285
Ser Gln Ile Arg Arg Thr Gln Asn Ser His Met Ser Pro Leu Glu Gly
290          295          300
Ser Arg Ser Gln Ser Pro Ser Arg Asp Asp Thr Ser Ser Ser Ser Gly
305          310          315          320
His Ser Ser Val Asp Thr Ile Pro Phe Phe Ser Glu Asn Leu Pro Ile
          325          330          335
Gly Glu Leu Phe Ser Tyr Val Asp Pro Leu Thr His Ala Leu Phe Ser
          340          345          350
Ala Cys Thr Thr Leu His Val Gly Val Gln Leu Leu Arg Glu Asn Glu
          355          360          365
Ile Thr Leu Gly Val His Ser Ala Gln Gly Ile Ala Ala Ser Ile Ser
370          375          380
Met Ser Gly Glu Pro Gly Glu Asp Ile Ala Arg Thr Gly Ala Thr Asn
385          390          395          400

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Ser Ala Arg Cys Glu Glu Gln Pro Thr Thr Pro Ala Ala Arg Val Leu
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 Phe Met Phe Leu Ser Asp Glu Gly Ala Phe Gln Glu Ala Lys Ser Ala
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 Gly Ser Arg Gly Arg Thr Ile Ala Ala Leu Arg Arg Cys Tyr Glu Asp
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<210> 92

<211> 1410

<212> DNA

<213> Artificial Sequence

<220>

<223> Wild-type lovE DNA sequence

<400> 92

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